Service Manual

ALADDIN II

HAMILTON MEDICAL

MAKING TECHNOLOGY SERVE MANKIND

PM Kit P/N 34001 UHS Stock# 1156197

Blender Maint Kit (Sechrist) UHS Stock# 1000725
P/N 3658

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1 IMPORTANT INFORMATION

The ALADDIN[II] SYSTEM is intended for use by properly trained personnel under the direct supervision of a licensed Medical Physician. In the USA, federal law restricts this device to sale by or on the order of a physician. Personnel must become thoroughly familiar with the Operator's Manual prior to using the device on a patient.

WARNINGS

The Functional Tests, as described in Section 4, must be performed prior to connecting a patient to the ALADDIN[II] System. If the system fails any of the prescribed tests, remove it from service immediately. ***DO NOT*** return the system to clinical service until any necessary repairs have been completed and all Functional Tests have been successfully completed.

DO NOT use the ALADDIN[II] System with anesthetics or in an explosive environment. Only compressed air and oxygen may be used. The gas supplies must be clean, dry, medical grade quality to prevent harm to the patient or damage to the Driver. Check for water and particle build up in the gas supply filter before each use. **Water or other contaminates in either gas supply will cause malfunction of this device and equipment connected to it.**

Blender alarms must be corrected immediately as the oxygen concentration selected for the patient will not be delivered during an alarm/bypass situation.

Ensure that the acoustic alarm is enabled before leaving the patient unattended. The green LED alarm light should be ON. The use of an alarm monitoring system does not give absolute assurance of warning for every form of malfunction that may occur with the system. In addition, some problems may require immediate attention. Therefore, whenever a patient is attached to respiratory care equipment, constant attendance is required by qualified personnel.

DO NOT attempt service procedures other than the routine preventative maintenance as specified in the Service Manual, P/N 610721 The preventative maintenance program requires a general service at least once a year. Only original manufacturer parts and accessories are to be used.

Any attempt to modify the hardware or software of this system without the expressed written approval of HAMILTON MEDICAL automatically voids all warranties and liabilities.

Oxygen vigorously accelerates combustion. To avoid explosion hazard, do not use with any other instrument or equipment that may have been exposed to oil or grease contamination.

CAUTIONS

The gas supplies must be made of clean, dry, medical grade quality to prevent harm to the patient or damage to the ALADDIN[II] Driver. Check for water and particle build up in the gas supply filter before each use.

The precision gas-mixing device incorporated in this device may become non-functional or damaged if used without the protective water trap and filters provided.

DO NOT immerse any part of this device. **DO NOT** gas or steam sterilize. Damage will result.

The Expiratory Limb on the Universal Generator must be fully extended prior to patient application.

2 PRODUCT DESCRIPTION

2.1 ALADDIN II SYSTEM

The ALADDIN^{II} System (Figure 2-1) is comprised of four components:

1. Driver
2. Delivery Circuit
3. Universal Generator with Prongs
4. Caps

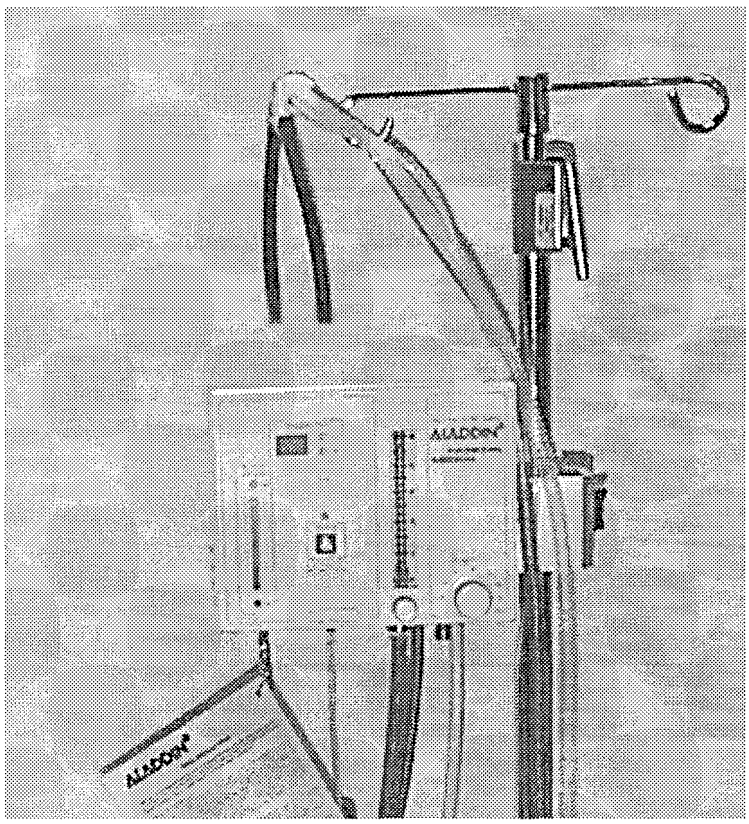


Figure 2-1

The ALADDIN^{II} Driver is the controller for the inspired gas source and the monitor for the system. It precisely mixes air and oxygen to the set oxygen percentage and controls the flow of the mixed gases to the patient circuit through a separate humidification system. For patient safety, the Driver is equipped with a digital pressure manometer with integrated high and low pressure alarms, as well as a pressure relief system for overpressure protection. The Driver also provides an oxygen analyzer with integrated high and low O_2 alarms.

2.2 ALADDIN^{II} DRIVER FRONT PANEL

The ALADDIN^{II} Driver front panel (Figure 2-2) is divided into three sections:

1. Monitor with alarms
2. Mixed gas flow control (flowmeter)
3. Air/O_2 blender

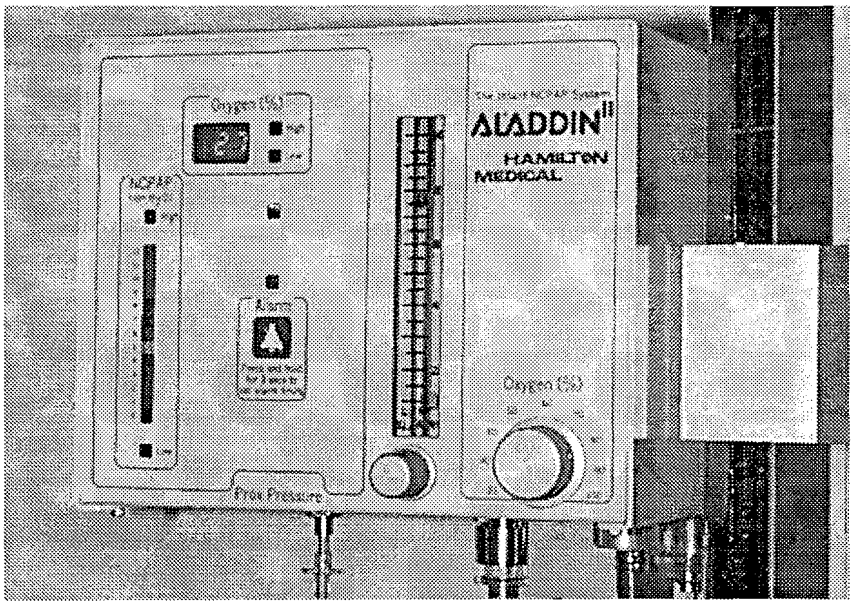


Figure 2-2

2.3 MONITOR SECTION

PRESSURE MONITOR

The proximal pressure line of the ALADDIN^{II} Universal Generator attaches to the proximal pressure port at the base of the Driver. The proximal pressure (Pprox) is measured in cmH_2O and displayed via a multicolored digital bar graph. The manometer pressure ranges from 0 to 12 cmH_2O. The bar graph is color coded for operational ranges:

COLOR	**PRESSURE (cmH_2O)**
Red	0
Yellow	1 – 3
Green	4 – 8
Yellow	9 – 12

Above and below the NCPAP bar graph are red LED's which will illuminate when HIGH and LOW pressure alarm limits are set or when the pressure alarm limits are violated.

OXYGEN ANALYZER

The measured O_2 (%) is displayed from 21% to 100%. Linearity of the analyzer should be checked prior to connecting the device to the baby. Red LED's are located to the right side of the digital Oxygen (%) display and will be illuminated when O_2 analyzer alarm limits are set and for O_2 alarm limit violations. On start up, the Oxygen (%) window will display the software version of the system for two seconds and then display the measured oxygen concentration.

FRONT PANEL LIGHT SENSOR

The front panel LED's brightness will automatically respond to changes in ambient light. The small, opaque window located directly above the Alarm set/silence softkey pad accomplishes this.

ALARM KEYPAD

The alarm keypad allows for the initial setting of the integrated alarm system as well as the reset mechanism for silencing and resetting the various alarms.

2.4 FLOW CONTROL SECTION

The flowmeter, located in the central panel of the ALADDIN[II] Driver (Figure 2-2), is a 0 to 10 Lpm non-back pressure compensated flowmeter. The flowmeter is graduated from 1 to 10 LPM. Turning the knob at the base of the flowmeter counterclockwise activates the flow. The set flow rate will determine the NCPAP level. **Ideally, when using the correct prongs size, a setting of 8 LPM should result in a pressure level of +5 cm H_2O of NCPAP.** It is recommended to check the required level of flow to achieve the desired pressure level prior to placing the prongs in the baby's nares. Refer to Section 4.. FUNKTIONAL TEST

2.5 AIR/O_2 BLENDER SECTION

The blender (mixer) can deliver from 21% to 100% oxygen concentration and is labeled in increments of 10%. Position the control knob indicator to obtain desired FiO_2. FiO_2 can be adjusted in 1% increments.

ALADDIN[II] DRIVER - LEFT SIDE PANEL

Two access ports for the calibration of the oxygen analyzer are located on the left side panel of the ALADDIN[II] Driver. Refer to Section 4. FUNKTIONAL TEST.

ALADDIN[II] DRIVER – RIGHT SIDE PANEL

The pole mount bracket is located on the right side panel of the ALADDIN[II] Driver. This bracket is designed for the attachment of the ALADDIN[II] Driver to the five-leg rolling pole stand. An oxygen analyzer calibration tool is attached next to the pole mount bracket

ALADDIN[II] DRIVER – REAR PANEL

The air and oxygen gas inlets are located on the lower left rear panel of the ALADDIN[II] Driver. The air inlet is equipped with a 5-micron inlet filter and manual drain. The high-pressure air and oxygen supply hoses connect via a male DISS fitting. See Figure 2-3

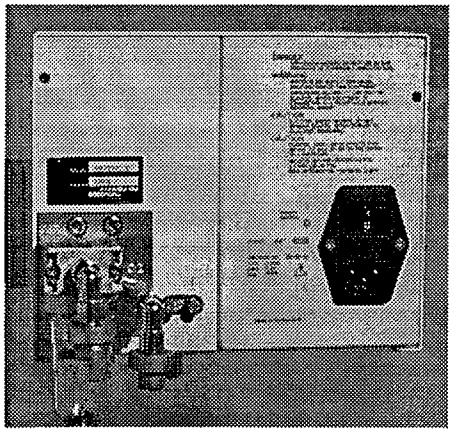


Figure 2-3

NOTE: ONLY CLEAN, DRY MEDICAL GRADE OXYGEN AND AIR SHOULD BE USED WITH THIS DEVICE TO PREVENT HARM TO THE PATIENT OR CAUSE DAMAGE TO THE ALADDIN^{II} DRIVER. CHECK FOR WATER OR PARTICULATE MATTER TRAPPED IN THE GAS SUPPLY FILTER BEFORE EACH USE.

Two (2) each sintered bronze bleed ports from the blender are located to the right of the gas inlets.

The ON/OFF toggle power switch is located on the right side of the rear panel above the power cord. The fuse holder is located in the center of the power entry module. A power cord strain relief is located below the power entry module.

The part number and the serial number are located in the central, left portion of the rear panel.

ALADDIN^{II} DRIVER – BASE

The pneumatic gas supply alarm is located directly below the gas inlets on the back panel. If either gas source (air or oxygen) varies more than 30 psi from the other gas source, an audible alarm will sound. Only restoration of the gas pressure will silence the alarm. A patient gas outlet (15-mm ID connector) provides the connection for the ALADDIN^{II} Delivery Circuit. The proximal pressure connection for monitoring the NCPAP level is located in the base of the Driver directly below the label Prox Pressure.

An auxiliary 50 psi outlet with check valve is located at the base of the blender to allow for delivery of blended gases via a supplemental flowmeter. See Figure 2-4, below.

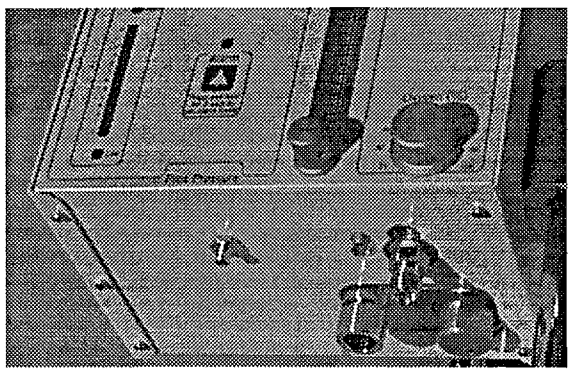


Figure 2-4

3 ALARM SYSTEM

3.1 GENERAL INFORMATION

Five (5) alarms are provided with the ALADDIN^{II} System. The Alarm keypad on the front of the ALADDIN^{II} Driver is used to temporarily silence (30 seconds) the audible alarm for all alarm violations except the GAS SUPPLY FAILURE and LOW HAZARD alarm. The OVER PRESSURE LIMIT alarm cannot be silenced until the over pressure condition has been corrected. If the cause of any patient alarm persists, the audible alarm will continue. **As with all medical devices, prompt response and immediate correction to all alarm conditions is recommended.**

The pressure monitor and pressure alarms will not be enabled if the proximal pressure line of the Delivery Circuit is not connected to the ALADDIN^{II} Driver and positive pressure is applied to the Prox Pressure port on the base of the Driver.

GAS SUPPLY FAILURE – This alarm will occur immediately if either AIR or OXYGEN supply gases fall 30 psi below the remaining gas supply. A pneumatic audible alarm will occur until the gas supply has been restored or both gas supplies have been disconnected from the source. This alarm cannot be manually silenced.

LOW PATIENT PRESSURE – The low NCPAP LED will illuminate and the audible alarm will sound after fifteen (15) seconds if the NCPAP level drops 2 cmH_2O below the alarm set point. If the pressure drops to ZERO (0) the alarm will sound within one (1) second. Check for proper placement of the nasal prongs in the nares or look for a leak in the circuit, at the humidifier, or at the baby's airway. The alarm limits should be manually reset (press and hold Alarm keypad for three (3) seconds) any time the NCPAP level is changed.

HIGH PATIENT PRESSURE – The high NCPAP LED will illuminate and the audible alarm will sound in fifteen (15) seconds if the NCPAP level exceeds 3 cmH_2O above the alarm set point. This alarm should be manually reset (press and hold Alarm keypad for three (3) seconds) any time the NCPAP level is changed.

OVER PRESSURE LIMIT – The high pressure NCPAP LED will illuminate and an audible alarm will sound immediately if the NCPAP pressure exceeds an internally preset limit of 10 cmH_2O. During the over pressure alarm condition, mixed gas flow will be interrupted. The ALADDIN^{II} Driver will attempt to restore gas flow after three (3) seconds. If the cause of the over pressure alarm is no longer present, there will be only a minimal interruption of NCPAP therapy. If the cause of the over pressure situation is still present, the Driver will divert gas flow again and continue to recycle until the cause of over pressure is corrected. This allows NCPAP treatment to be automatically restored if, for example the baby coughs, without compromising safety. The visual and audible alarm will reset when the condition is corrected.

OXYGEN CONCENTRATION ALARM – Alarm limits for Oxygen (%) are set at + and – 5% of the set FiO_2. If the measured oxygen percentage should drop more than 5% below the alarm set point, the Low LED in the Oxygen (%) window will illuminate and the audible alarm will sound after fifteen (15) seconds. If the measured oxygen percentage should rise 5% above the alarm set point, the High LED in the Oxygen (%) window will illuminate and an audible alarm will sound after fifteen (15) seconds. The maximum upper limit is 101% and the lower minimum limit is 19%.

NOMINAL OXYGEN ALARM – When the F_IO_2 is changed by greater than + or – 10%, the display window will show the new measured value for fifteen (15) seconds. If the alarms are not set around the new F_IO_2 within that time, the display will show three (3) dashes. The audible alarm will sound and both the high and low LED visual alarms will light. Push the Alarm button, the display will show the delivered F_IO_2 and silence the audible for thirty (30) seconds. The visual will clear after the new alarm limits are set.

LOW HAZARD ALARM - There is a low hazard warning alarm if the Oxygen (%) reading is less than or equal to 18%. This alarm can not be silenced. Check the linearity of the oxygen analyzer. To verify proper calibration, refer to Section 4.1, page 10; OXYGEN ANALYZER CALIBRATION. The most common cause of this alarm condition is depletion of the fuel cell and a change of the oxygen cell is needed. Refer the Driver to the biomedical department for replacement of the oxygen cell. Press and hold the Alarm keypad for three (3) seconds) any time an adjustment of more than 4% is made in the Oxygen (%) control knob.

NOTE: If the proximal pressure tubing is NOT connected to the base of the ALADDIN^{II} Driver when the power is turned on, the pressure bar graph will not be illuminated. This allows the Driver to deliver analyzed, blended gas to other oxygen devices (oxygen hood, nasal cannula, etc.) without continuous audible pressure alarms.

3.2 INITIAL ALARM SET-UP

To set all patient alarms, press and hold the Alarm keypad for three (3) seconds until alarm limits flash and a series of beeps are heard. If alarm limits are not manually set, alarms will automatically set after two (2) minutes. Pressure alarms are set at 3 cmH_2O above and 2 cmH_2O below the measured NCPAP level at the time the alarm is set. Oxygen alarms are set at 5% above and 5% below the level of the Oxygen (%) control knob setting at the time the alarm is set.

3.3 RESETTING OF ALARM VIOLATIONS

To reset a violated alarm, briefly press the Alarm keypad. Verification and correction of any alarm violation should be accomplished as quickly as possible. Alarm will silence for only thirty (30) seconds if alarm condition persists. Refer to Section 9 TROUBLESHOOTING GUIDELINES for detailed information concerning specific alarms.

3.4 SOFTWARE VERSION IN THE ALADDIN^{II} DRIVER

The software version for each ALADDIN^{II} Driver is visible during the initial power up procedure. When the ALADDIN^{II} Driver power is turned ON, the Oxygen (%) window will briefly display "888" and then follow with the software version installed in that Driver. The oxygen percentage will then be displayed.

4 FUNCTIONAL TESTS

4.1 BLENDER ALARM – FUNCTIONAL TEST

To verify if the blender alarm is functioning properly, attach only one gas source. A shrill audible alarm will sound. Connect other gas source, alarm will cease. Disconnect first gas source connected, alarm will sound again.

Observe the water trap of the air inlet pressure line at the back of the ALADDIN^{II} Driver for any liquid or debris. Contamination of air inlet gas source may cause failure of the ALADDIN^{II} Driver. To remove water from the water trap, press the manual drain on the bottom of the water trap bowl. To remove particulate debris, disconnect hoses from gas supply and unscrew clear plastic bowl. **Take care not to dislodge sealing O-ring from inside the water trap assembly.** Notify hospital medical maintenance (biomedical engineering) if either excess water or debris is noted in the air water trap bowl.

4.2 OXYGEN ANALYZER – FUNCTIONAL TEST

It is not necessary, nor is it required, to calibrate the oxygen analyzer before each use. To ensure proper calibration of the analyzer, a functional check should be made to verify a proper reading of the analyzer in comparison to the oxygen blender. The desired acceptability range is + or -1% to 2%.

Adjust Oxygen (%) control knob to 21. Observe Oxygen (%) display window for 21% (+ or – 2%). Turn the Oxygen (%) to 100. Observe the Oxygen (%) display window for 100% (+ or - 2%). Turn Oxygen (%) to 50 (+ or – 2%) and observe Oxygen (%) display for proper reading. If oxygen analyzer needs calibration, refer to Section 8; CALIBRATION.

4.3 PRESSURE MANOMETER- FUNCTIONAL TEST

Before attaching the ALADDIN^{II} Universal Generator Set to the baby, it is advisable to verify the proper flow to pressure ratio of the ALADDIN^{II} System. This is accomplished by attaching the Delivery Circuit, Universal Generator with Prongs and a humidification system to the Driver. Follow instructions in Operator's Manual.

1. Attach the ALADDIN^{II} Driver gas supply line into medical grade Air and Oxygen gas sources.
2. Plug the power cord into a grounded hospital grade outlet.
3. Attach the ALADDIN^{II} Delivery Circuit and Universal Generator with Prongs to the Driver.
4. Turn the ALADDIN^{II} Driver power ON.
5. Turn the flowmeter knob counterclockwise until it reads 8 LPM.
6. Occlude the Prongs to stop gas from escaping.
7. The NCPAP Pressure display should register approximately 5 cmH_2O at 8 liters of flow.
8. Release the Prongs. Pressure should drop to zero (0 or +1 cmH_2O) when Prongs are not obstructed.
9. Increase in flow should result in an increase in NCPAP pressure.
10. Decrease in flow should result in a decrease in NCPAP pressure.

If the pressure manometer does not register, insert the clear, proximal pressure line from the Generator/Prongs into Prox Pressure port located on the base of the Driver and reestablish flow.

If pressure manometer does not correspond to the proper flow changes and a complete check of the delivery circuit and humidifier has verified there is no occlusion or air leak in the circuit, change the ALADDIN^{II} Generator or Delivery Circuit. Following replacement of Generator, circuit or humidifier chamber, repeat steps 1 through 10 above until proper reading is obtained. If unable to obtain proper pressure reading, notify hospital medical maintenance.

5 PNEUMATIC

5.1 GAS INLET BLOCK

The Gas Inlet Block is the ALADDIN II Ncpap systems connection to the Air and Oxygen 50 PSI sources. The gas connections are DISS fittings. A water trap / filter assembly is located on the air side. The air filter is 5 micron. The gas block is located at the left side of the rear panel. The two screws securing the gas block to the ALADDIN II are 3/16" allen head.

5.2 GAS BLENDER

The gas blender consists of three modules. They are the nulling regulator, proportioning valve and Bypass module.

5.2.1 *Nulling Regulator*

The nulling regulators first function is to filter out any impurities from the air and oxygen. This is accomplished by two small sintered metal filters (5 micron). The next step is to prevent cross contamination of the gas sources with two "duck bill" valves. These duck bills prevent one gas source from back feeding through the gas blender. The last function is to compensate for unequal air/oxygen source pressures. Equal input pressures will result in equal gas flow from the air and oxygen sides of the nulling regulator. Input pressure imbalances will be compensated for by restricting the orifice on high pressure side and allowing the lower pressure side orifice to open more. This will provide consistent gas sources to the proportioning valve for input pressure variations of up to $\pm$ 2 Bar max.

5.2.2 *Proportioning Valve*

The proportioning valve is the module that blends the air and oxygen . The oxygen is set by the control knob on the right front of the ALADDIN II. This knob controls a small metal cylinder that is tapered from the middle to each end (like a football). The position of this football proportions the gas flow from the air and oxygen outputs of the nulling regulator. This blended gas is then delivered to the flow meter block and the auxiliary output on the bottom of the ALADDIN II.

5.2.3 *Bypass module*

In the event of a pressure differential of greater than 2 bar at the gas inputs, the bypass module will perform 2 functions. One will be to bypass the low gas source and allow only the higher pressure source to be delivered out of the patient port. The other will be to provide a flow of gas to the reed alarm. This audible alarm will notify the user of a gas source failure.

5.3 FLOW METER ASSEMBLY

5.3.1 *Block Sub-Assembly*

The Block Sub-Assembly controls gas flow to the patient and oxygen cell. This assembly also contains the patient over pressure solenoid and circuit over pressure valve.

5.3.2 *Flow Meter*

The Flow Meter controls gas flow from the gas blender to the patient. In clinical use 8L/pm should deliver 5cmH_2O.

5.3.3 *Oxygen Cell*

The oxygen cell is a galvanic oxygen cell. It obtains a side stream sample of blended gas from the gas blender and exhausts this sample gas out of the rear panel. This exhaust port is protected by a small brass filter. The oxygen cell requires a two point calibration for proper operation. This cell is replaced at the annual preventative maintenance.

5.3.4 *Patient Over Pressure Valve*

The Patient Over Pressure Valve is an electronically controlled solenoid. In the event of a patient over pressure, this solenoid diverts gas flow from the patient to the rear panel exhaust port. The exhaust port is protected with a small brass filter.

5.3.5 *Circuit Over Pressure Valve*

The Circuit Over Pressure Valve is a spring loaded pressure relief device. If the Patient Port or the patient circuit is occluded, the valve will open at a preset pressure of 150 cmH_2O. The gas flow will be diverted for the duration of the occlusion.

5.4 PRESSURE MEASUREMENT

5.4.1 *Proximal Pressure Port*

The proximal pressure port is located on the bottom of the ALADDIN II driver below the electronic module (left side). It is a female luer type connector.

5.4.2 *Proximal Pressure Transducer*

The pressure transducer is mounted to the main circuit board. It has a two point calibration (offset – gain). The offset will be calibrated to 1 cmH_2O and the gain to 10 cmH_2O. The offset is calibrated at 1 cmH_2O to obtain maximum accuracy as the pressure transducer gain ramp has a sharp drop at the zero point.

6 MAIN CIRCUIT BOARD

6.1 PRESSURE MONITORING

The NCPAP is measured via the Proximal Pressure Port on the bottom of the ALADDIN II Driver. This Proximal Pressure Port is connected to the pressure transducer (U5). This signal is amplified by U4 and U9. The gain at U4 is fixed (R3). The pressure transducer zero (offset) is adjusted with R48 and the gain is adjusted with R46. A zener diode (D26) is used at U9 signal output to prevent an over voltage at the input of the ADC (U7) in the event of an overpressure or vacuum at the Proximal Port.

The digitized signal is then multiplexed at U10 and displayed on a LED Bar Graph. This bar graph is called the Pressure Manometer.

In operating mode this Pressure Manometer will only activate after the system acknowledges 2 cmH_2O at the Proximal Port for 3 seconds. Once the manometer is activated, the pressure will display continuously, regardless of the proximal pressure.

6.2 OXYGEN MONITORING

The Oxygen Monitoring begins with the Oxygen Cell. The ALADDIN II uses a galvanic O_2 cell that is mounted on the Flow meter Block. The connection at the cell is the three pin Molex variety and this harness connects to the Main Circuit Board at connector # P4. A two point calibration is required.

The Oxygen signal is then amplified by U11 with a fixed gain set by R43 and R44. The input of U11 also is connected to R42. This will allow the signal to go to 0V and trigger an Oxygen alarm in the event of a disconnected Oxygen Cell.

The two point Oxygen Cell calibration is performed at U6 using R50 for the 21% and R45 for the 100%.

The signal is the processed at an ADC (U7) and multiplexed at U8 for display on three 7 segment LED's.

6.3 ALARM SYSTEM

6.3.1 *Buzzer*

The Buzzer (DS1) is controlled by the microprocessor (U7) via a FET (Q1). The power is supplied from the 5 volt supply. The 15 volt supply is used as a backup with a zener diode (D23) to provide power in the event of a 5 volt failure.

6.3.2 *Alarm Switch (front panel)*

The alarm switch is used in several functions. It serves as a 30 second silence during low/high Oxygen and low/high pressure alarms. (See alarm section for additional alarm information)
The oxygen and pressure alarm points can be set by pressing and holding the alarm button for 3 seconds. When this step is performed the alarm LED's will flash and a series of beeps will be heard. The switch is also used for activating Test Software (TSW).

6.3.3 *Oxygen Set Point Potentiometer*

This potentiometer (R blender) is located at the gas blender control setting. It is secured to the front of the blender and it tracks the blender setting via 2 sprockets. One secured to the blender shaft and the other to the Oxygen Set Point Potentiometer. A change in gas concentration results in a corresponding change in resistance. This allows the processor to know the "set point" for the oxygen concentration alarms. The potentiometer is calibrated using R47 for the offset and R49 for the gain. R19 will force the amplifier input to 0 volts in the event of a potentiometer disconnection or failure. This will cause an Oxygen Nominal Alarm. This alarm cannot be silenced.

6.4 AUTO DIMMING FEATURE

The light "brightness" is measured using an optical sensor (U4). This signal is amplified with U6 and then processed by the ADC in U7. A zener diode (D25) is used to protect the ADC input from over voltage. The display brightness will be 100% for ADC values of 50 and greater and 50% for ADC values of 35 and less.

6.5 PATIENT OVER PRESSURE PROTECTION

The Patient Over Pressure Protection Valve is a normally closed solenoid controlled by the microprocessor. If the Proximal Pressure exceeds a pressure of 11 cmH_2O the microprocessor will activate the solenoid. This allows the gas flow selected at the flow meter to flow through the solenoid and out of a brass sound absorber on the rear panel, the path of least resistance. The patient pressure at this point would drop to zero. After 3 seconds the processor will attempt to restore flow to the patient circuit. If the over Pressure condition is still present the solenoid will open again. This process will repeat until the condition is cleared.

The solenoid is mounted on the Flow Meter Block and is connected to the Main Circuit Board at connector #P5. It is activated by a FET (Q3)

6.6 + 15 VOLT MONITORING

The + 15 volt supply is monitored with R38 and R39 in series across the +15 volt supply and 15v ground. The voltage at the node is input to the ADC where the digital value is monitored. The value must keep the + 15 volt at ± 10% tolerance. Failure to do so will result in a watch dog reset of the microprocessor.

The –15 volt supply is monitored with R40 and R41 in series across the –15 volt supply and the +10 volt reference. The + 10 volt reference allows the node voltage to be positive to accommodate the ADC input (input can not be negative). This digital value is monitored to verify that the -15 volt supply remains within the ±10% tolerance. Failure to do so will result in a watch dog reset of the microprocessor.

6.7 REFERENCE VOLTAGES

V ref +4.76 Volts ±0.03V

V ref is derived with R4, R7 and U6. The voltage at the node of voltage divider R4 and R7 is driven by U6, a high input impedance op amp.

Precision Voltage ±10.00 Volts

The +15 volt supply used by U2 to deliver a stable 10 volt output. U1's function is the driver for both the ± 10 volt supply. The output of U2 is stable at voltages down to +12 volts.

6.8 TEST POINTS AND TEST SOFTWARE (TSW)

The test points are located at P6. Pin 1 is located at the top of the connector, 13 at the bottom.

P6 / 1	Ground
P6 / 2	Pressure signal – To ADC
P6 / 3	Reference voltage +4.76 V ±0.03V
P6 / 4	+15 V control voltage to ADC
P6 / 5	- 15 V control voltage to ADC
P6 / 6	Oxygen set point to ADC (nominal alarm)
P6 / 7	Optical sensor output voltage to ADC
P6 / 8	+5 volt – Digital Power
P6 / 9	+15 volt – Analog Power
P6 / 10	Oxygen Cell voltage to ADC
P6 / 11	-15 volt – Analog Power

P6 / 12 +10 volt – Analog Precision Voltage
P6 / 13 -10 volt –Analog Precision Voltage

Test Soft Ware Switch (TSW)

The Test Switch is a 16 position, 4 line Hexadecimal code switch. To enable TSW the following steps must be followed:

1. Place switch in position 1
2. Press and hold the ALARM key on the front panel.
3. Turn Main Power on
4. Release ALARM switch after software revision is displayed.
5. Follow instructions in section 8.

7 POWER SUPPLY

7.1 POWER SUPPLY BOARD

The ALADDIN II power supply module is a switching power supply providing the following outputs:

+5 volts	3 amp max output
+15 volts	2 amp max output
-15 volts	0.3 amp max output

The power supply input specifications are:

7.2 POWER INPUT MODULE

The power input module is a class B filter type suitable for medical use. The power input module also contains the primary fuses rated at 2 amp slow blow (2AT).

7.3 LOAD RESISTORS

The load resistors are located on the bracket forward of the power supply module. They are used as additional load on the power supply module to allow maximum efficiency of the switching supply.

8 CALIBRATION

The electronic calibration must be performed by qualified personnel. The calibration procedure must begin with the instrument disconnected from AC power and gas sources. The following procedure will be completed during the annual preventative maintenance and repairs of the ALADDIN II.

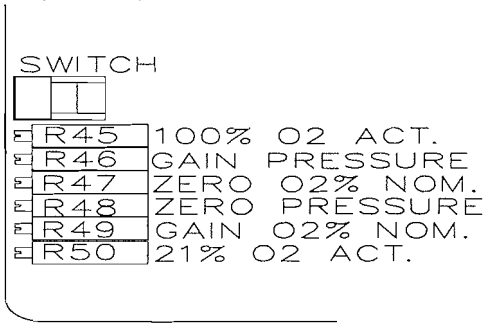
Electronic Calibration Set Up

1. Disconnect AC power and Gas Sources.
2. Remove ALADDIN II from the I.V. stand if attached.
3. Remove two screws at pole mount on right side of unit.
4 .Remove five screws on bottom enclosure.
5 .Resecure pole mount to the right side of the unit.
6. Attach unit to I.V. stand and connect AC power.
7. With the power OFF, set the test switch to position 1 (TS 1). The test switch is located on the left side of the unit, above the calibration potentiometers.
8. Press and hold the Alarm Reset Button on the front Panel and turn on the main power switch ON.
9. After the Software Version has been displayed on the oxygen display release the Alarm Reset Button.
10. The ALADDIN II is now in test mode.

TS1 Oxygen Cell Calibration

At Position 1, the oxygen display shows the actual oxygen value x2. This Value is from the ADC converter and allows the 2-point calibration of the oxygen cell.

-Connect Air and Oxygen. Display reads 2x oxygen value.
- -Set Oxygen knob to 100%, allow 1 minute to stabilize.
- -Disconnect the air supply (The whistle will be ON)
- -Adjust 100% calibration potentiometer for display of 200 **(R45).**
- -Reconnect the air supply (The whistle stops)
- -Set Oxygen knob to 21%, allow 1 minute to stabilize.
- -Disconnect the oxygen supply (The whistle will be ON)
- -Adjust 21% calibration potentiometer for display of 42-43 **(R50).**
- -Reconnect the oxygen supply (The whistle stops)
- -Repeat steps until no adjustment is required.



NOTE: WHEN INSTALLING A NEW GALVANIC OXYGEN CELL, ALLOW THE CELL PPROXIMATELY 30 MINUTES TO REACH ROOM TEMPERATURE BEFORE CALIBRATION.

TS2 Oxygen Blender Alarm Position Potentiometer Calibration

The blender alarm potentiometer's function is to allow the microprocessor an electronic method of determining where the gas blender is set to for comparison to the actual oxygen value. A nominal oxygen alarm would result if the values did not coincide.

At position 2, the oxygen display will show the blender alarm potentiometer value x two. This value is

from the ADC converter and allows the blender potentiometer to be calibrated to the gas blender.

-Turn test switch to position 2.
-Display reads 2x the effective value.
-Set oxygen concentration to 100 %.
-Adjust Gain O2 Nominal potentiometer for display of 200 **(R49)**.
-Set oxygen concentration to 21%.
-Adjust Zero O2 Nominal potentiometer for display of 42-43 **(R47).**
-Repeat steps until no adjustment is needed.

TS3 Pressure Manometer Calibration

At position 3, the ADC will convert the analog pressure transducer output to a digital signal for the oxygen display. The display will read x 16 the effective value. The LED display is scaled from 0 – 12 cmH_2O. A 2 point calibration is required.
** The display value cannot be negative and cannot be greater that 255.**
Zero Pressure potentiometer must be calibrated at 1 cmH2o (16 on display).
-Connect the manual pressure pump and a Pressure controller to the pressure connector
-Set pressure to 10 cmH2O.
-Adjust Gain Pressure potentiometer for a value of 160 $\pm$ 1.
-Set pressure to 1 cmH2O.
-Adjust Zero Pressure potentiometer for a value of 16 $\pm$ 1.
-Repeat steps until no adjustment is required.

TS 4 Display Auto-Dimming Check

At position 4, the digital display will show a value from the ADC indicating the brightness level of the LED displays.

-Display value above 50 = Max intensity.
-Display value below 35 = Low intensity.

TS5 + 15 Volt Analog Supply Check

At position 5, the digital display will indicate a value from the ADC. If the value is out of range for longer than 50 ms, a watchdog reset is executed.
-Display value range 189 – 231.

TS6 - 15 Volt Analog Supply Check

At position 6, the digital display will indicate a value from the ADC. If the value is out of range for longer than 50 ms, a watchdog reset is executed.

-Display value range 59 – 113.

TROUBLE SHOOTING TESTS

TS7 – TSC Oxygen and Pressure Alarm Set Points and Low/High Alarm Points.

The sequence of TS 7 – TSC will check the alarm set points programmed by holding the ALARM RESET button for 3 seconds. In calibration mode it allows the technician to verify the Pressure and Oxygen set point as well as the low and high alarm points.

Oxygen Alarm Test

- Set test switch to position 2
- Set oxygen to a defined value on the digital display (set point). The set point should not be higher than 200 or lower than 42. The high limit should not be higher than 202. Record value.
- Press alarm reset button for 3 seconds. (Audio alarm and alarm LEDs)Return to position 7.
- The displayed value is the set point.
- Position 8 is the High Limit value.
- This value must be 9 higher that the set point.
- Position 9 is the Low Limit value.
- This value must be 9 lower than the set point.

9 TROUBLESHOOTING GUIDELINES

ALARM	INDICATION	SOLUTIONS
Low pressure indicator light with audible alarm	Low CPAP level	1. Prongs are not in proper position 2. Check for a disconnect or occlusion in patient circuit 3. Prongs are too small for baby's nose 4. Alarm was not reset when CPAP level decreased 5. Prongs are not attached properly to generator 6. Infant losing pressure from the mouth (may use pacifier to achieve proper seal) 7. Notify medical maintenance to check Driver.
High pressure indicator light with audible alarm	High CPAP level or overpressure in the system	1. Check for an occlusion or kink in the expiratory line 2. Check circuit for kinks or occlusion 3. Check nasal prongs for mucous plug 4. Alarm limit was not reset when CPAP level increased.
Low oxygen indicator light with audible alarm	FiO_2 too low for blender setting	1. Recalibrate the oxygen analyzer 2. Oxygen supply disconnected or pressure low in oxygen supply source 3. Oxygen concentration changed and alarm not reset. Press and hold Alarm key pad for three (3) seconds. 4. Oxygen fuel cell needs to be replaced
High oxygen indicator light with audible alarm	FiO_2 too high for blender setting	1. Recalibrate the oxygen analyzer 2. Air supply disconnected or pressure drop in the air supply source 3. Oxygen fuel cell needs to be replaced 4. Oxygen concentration changed and alarm needs to be reset. 5. Notify medical maintenance to check for damage to potentiometer during analyzer calibration.
- - - in the Oxygen display with Low Oxygen indicator and audible alarm	< 18% Oxygen	1. Check the O_2 setting on the blender 2. Recalibrate the oxygen analyzer 3. Oxygen fuel cell needs to be replaced
No pressure reading	No pressure display	1. Connect proximal pressure line to driver
Err in the Oxygen display with High Oxygen indicator and audible alarm	>+10% Oxygen value between the display and blender	1. A difference of >+10% is found in the potentiometer setting for the blender, recalibrate the oxygen analyzer
Err in the Oxygen display with Low Oxygen indicator and audible alarm	>-10% Oxygen value between the display and blender	1. A difference of >-10% is found in the potentiometer setting for the blender, recalibrate the oxygen analyzer

ALARM	INDICATION	SOLUTIONS
High pressure indicator light with audible alarm and pressure at 0 pressure	Pressure > 11 cmH_2O	1. Pressure exceeded preset limit 2. Check for occlusion or kink in the proximal pressure line 3. Check for occlusion of the expiratory limb extension
--- in the Oxygen display with High and Low indicator and audible alarm	Disconnect of the blender knob from the blender	1. Check connections
No audible alarm No visual display	Power failure to the driver	1. Power on the driver 2. Verify electrical connection

10 ROUTINE AND PREVENTATIVE MAINTENANCE

10.1 CLEANING

Cleaning the exterior surfaces of the ALADDIN[II] Driver can be accomplished with a mild soap or liquid disinfectant solution. Do not use cleaning agents that contain abrasives or acetone.

NOTE: THE ALADDIN[II] DELIVERY CIRCUIT, CAP, GENERATOR AND PRONGS ARE SINGLE PATIENT, SINGLE USE ITEMS. THE FLUIDIC ELEMENT IS NOT COMPATIBLE WITH, AND MAY BE DAMAGED BY HEAT, LIQUID OR ETO STERILIZATION AGENTS. STERILIZATION AND REUSE OF THE DELIVERY CIRCUIT, GENERATOR OR PRONGS MAY RESULT IN INJURY OR DEATH TO OPERATORS, PATIENTS OR BYSTANDERS.

10.2 ROUTINE MAINTENANCE

An ALADDIN[II] Driver in need of recalibration, service or repair must not be used until the necessary procedures are performed and the equipment has been tested to ascertain that it is functioning correctly.
The Performance Verification Procedure provides a means of determining whether the ALADDIN[II] Driver meets its design specifications. These tests are intended to be performed in the hospital by qualified personnel. The procedure should be performed at least every four (4) months or more frequently if desired or if conditions warrant. Refer to Section 4, FUNCTIONAL TESTS, in the ALADDIN[II] Service Manual (P/N 610721)

10.3 PREVENTATIVE MAINTENANCE

An authorized service representative should perform preventative maintenance every twelve (12) months. The annual preventative maintenance will consist of replacing oxygen cell, Air Side Filter followed by a complete calibration as listed in Section 8, Calibration in the ALADDIN[II] Service Manual (P/N 610721)

11 WARRANTY

HAMILTON MEDICAL warrants this product to be free from defects in construction, material and workmanship for a period of one (1) year when operated properly under conditions of normal use for which the product was intended. This twelve (12) month warranty does not extend to expendable items such as the Delivery Circuit, Generator with Prongs, and Caps, which are warranted to be free of defects only at the time of original delivery.

HAMILTON MEDICAL will, at its option, either repair or replace any defective product, as above defined, which is reported during the warranty period. Such defective products must be returned to HAMILTON MEDICAL in the original carton with freight charges prepaid. HAMILTON MEDICAL shall be responsible for repairs to, or replacement of, such defective product only.

LIMITATIONS ON AND DISCLAIMER OF WARRANTIES:

HAMILTON MEDICAL. shall be relieved of any liability under this warranty if:

a) the product has not been used in accordance with manufacturer's instructions;
b) no evidence is present that the occurrence of damage/repair is within the certified warranty period;
c) the serial number has been altered, effaced or removed and there is no bill of sale or evidence to verify the product's purchase date;
d) regular periodic maintenance and service is not performed;
e) repairs are made by other than authorized HAMILTON MEDICAL personnel;
f) the product has been subject to abuse, misuse, negligence or accident;
g) the product has been mechanically or electronically altered without specific written authorization from HAMILTON MEDICAL

The warranty described in this Agreement is in lieu of all other warranties. THE PARTIES AGREE THAT THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND ALL OTHER WARRANTIES, EXPRESS AND IMPLIED, ARE EXCLUDED FROM THIS AGREEMENT.

Except as stated above, HAMILTON MEDICAL SHALL NOT BE LIABLE FOR ANY DAMAGES, CLAIMS OR LIABILITIES INCLUDING, BUT NOT LIMITED TO, PERSONAL BODILY INJURY, OR INCIDENTAL, CONSEQUENTIAL, OR SPECIAL DAMAGES.

Replacements and/or repairs furnished under this Limited Warranty do not carry a new warranty, but carry only the unexpired portion of the original Limited Warranty.

Any person may not vary the terms of this Limited Warranty, whether or not purporting to represent or act on behalf of HAMILTON MEDICAL

To obtain service under this Limited Warranty, claimant must promptly notify HAMILTON MEDICAL of the nature of the problem and the serial number of the device. If HAMILTON MEDICAL, determines that the repair is required under this Limited Warranty, the defective device or respective part must be returned to HAMILTON MEDICAL or an authorized service center. Item must be properly packaged, insured and shipped to HAMILTON MEDICAL postage/freight paid by claimant.

12 TECHNICAL SPECIFICATIONS

CONTROLS:

Flow 0 to 10 lpm
Oxygen 21 to 100 %

PATIENT MONITORING INFORMATION:

NCPAP.....0 to 12 cmH2O
Oxygen.....21 to 100 %
Autodimming Display

ALARMS:

High and Low Pressure.....0 to 12 cmH2O
High and Low Oxygen.....18 to 101 %
Hazard ..... < 18 %
Gas Supply.....Differential Pressure
> 2 bar (29 psig)

INPUTS:

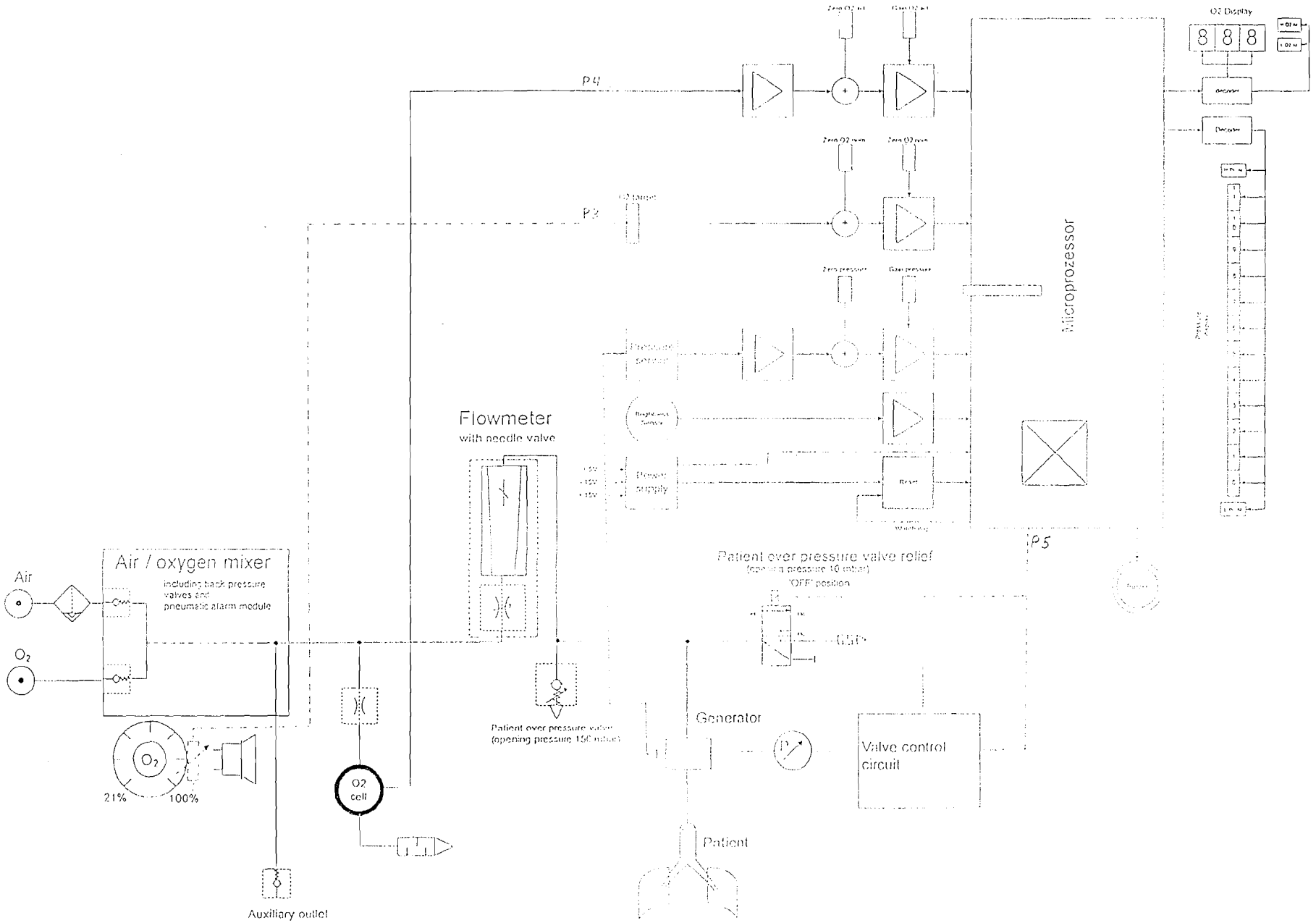
Gas Supply .2 to 6 bar (30 to 90 psig)
Power Supply.....100/240 VAC, 50 Hz, 45 VA

SIZE:

Dimensions (W x H x D).....210 x 175 x 145 mm
Weight..... 6.1 Kg. (13.5 lbs.)

Hamilton Medical AG

BABYVENT
Electronic hardware blockdiagram



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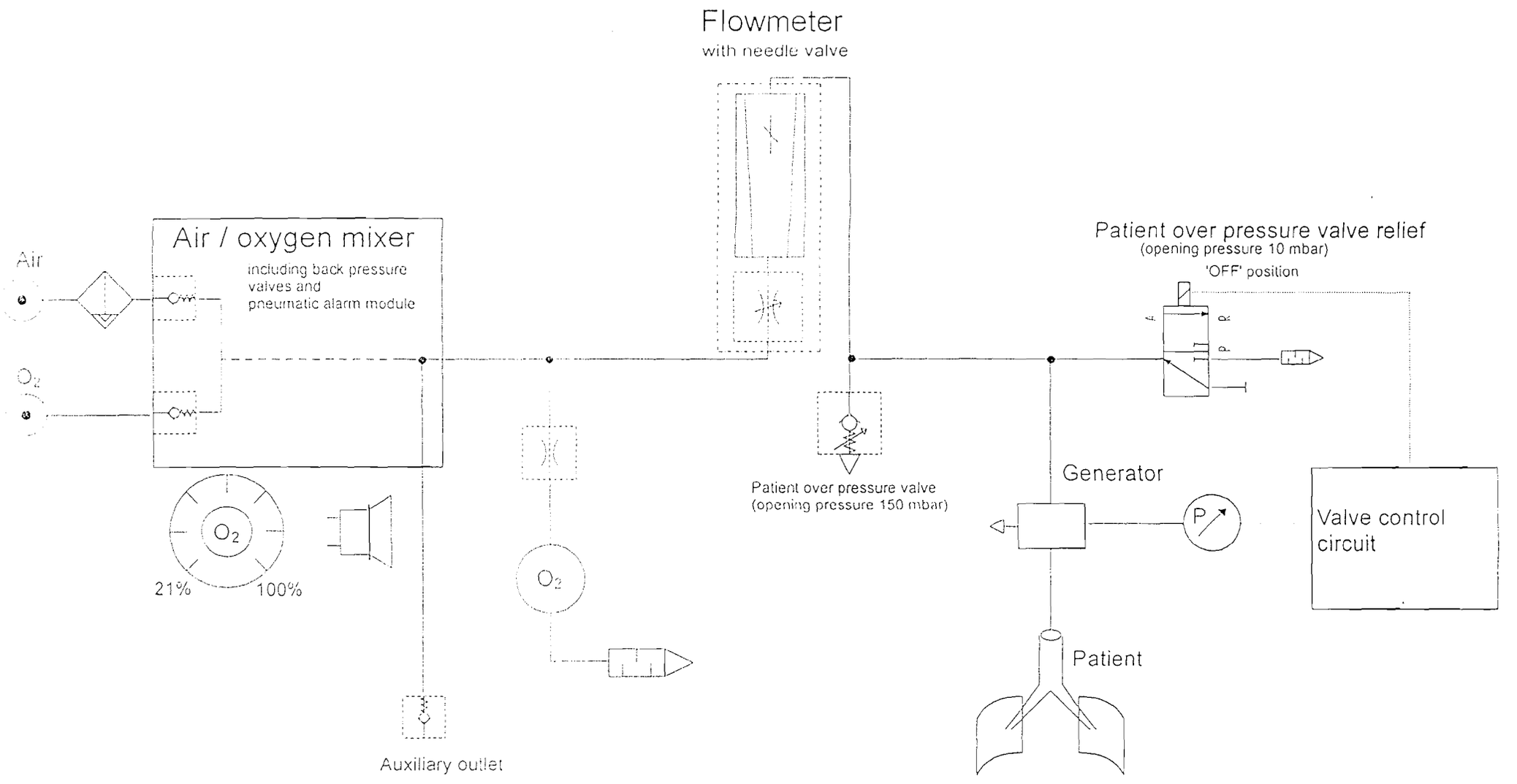
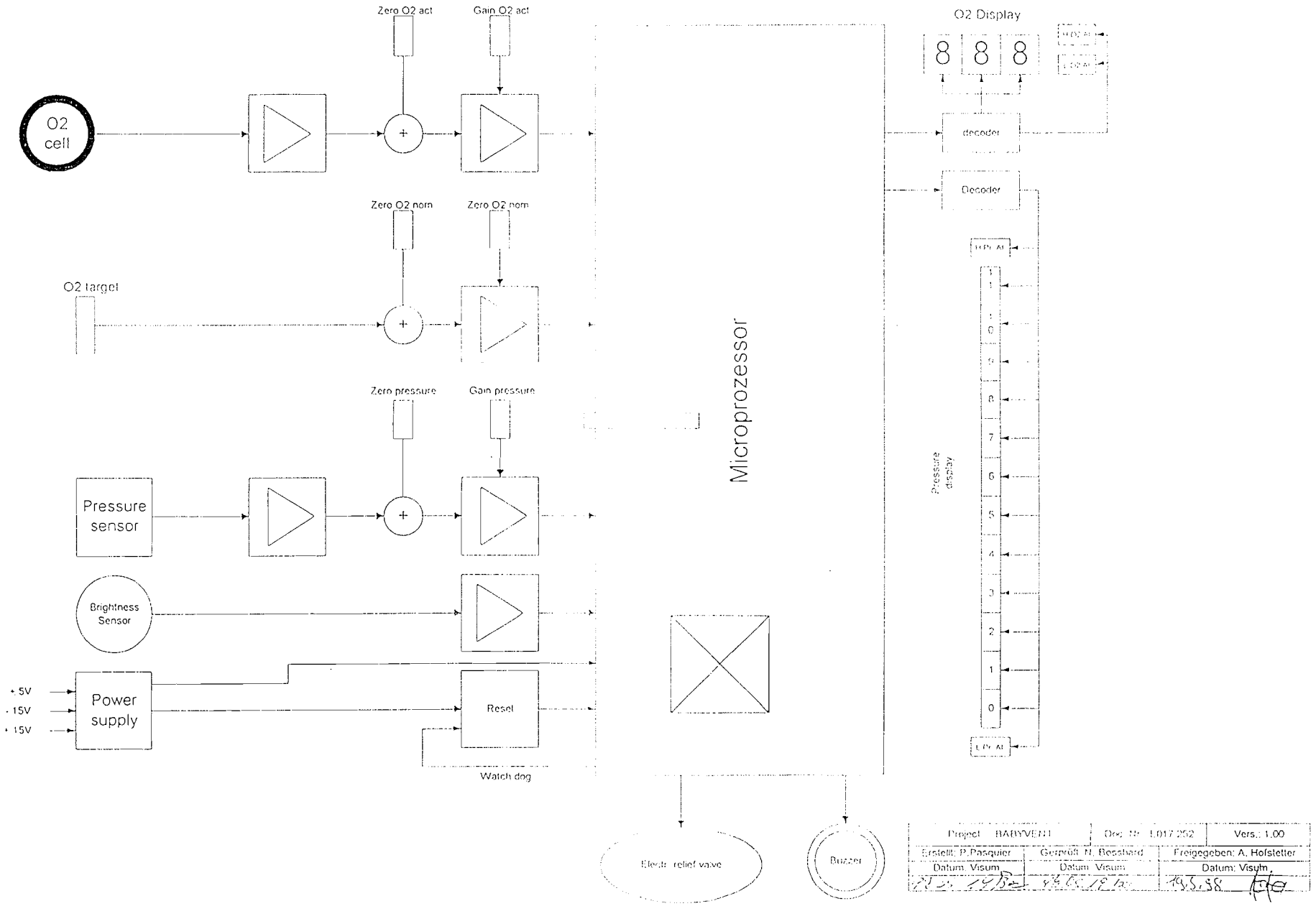


Pneumatic Diagram ALADDIN II		Format A4	Blatt 1 von 1
	Gez. Heinz Pokorny	1999-06-02	
	Gepr.	1999-06-02	
HAMILTON MEDICAL AG	SA 604.128		Rev 01

Hamilton Medical AG

BABYVENT
Electronic hardware blockdiagram



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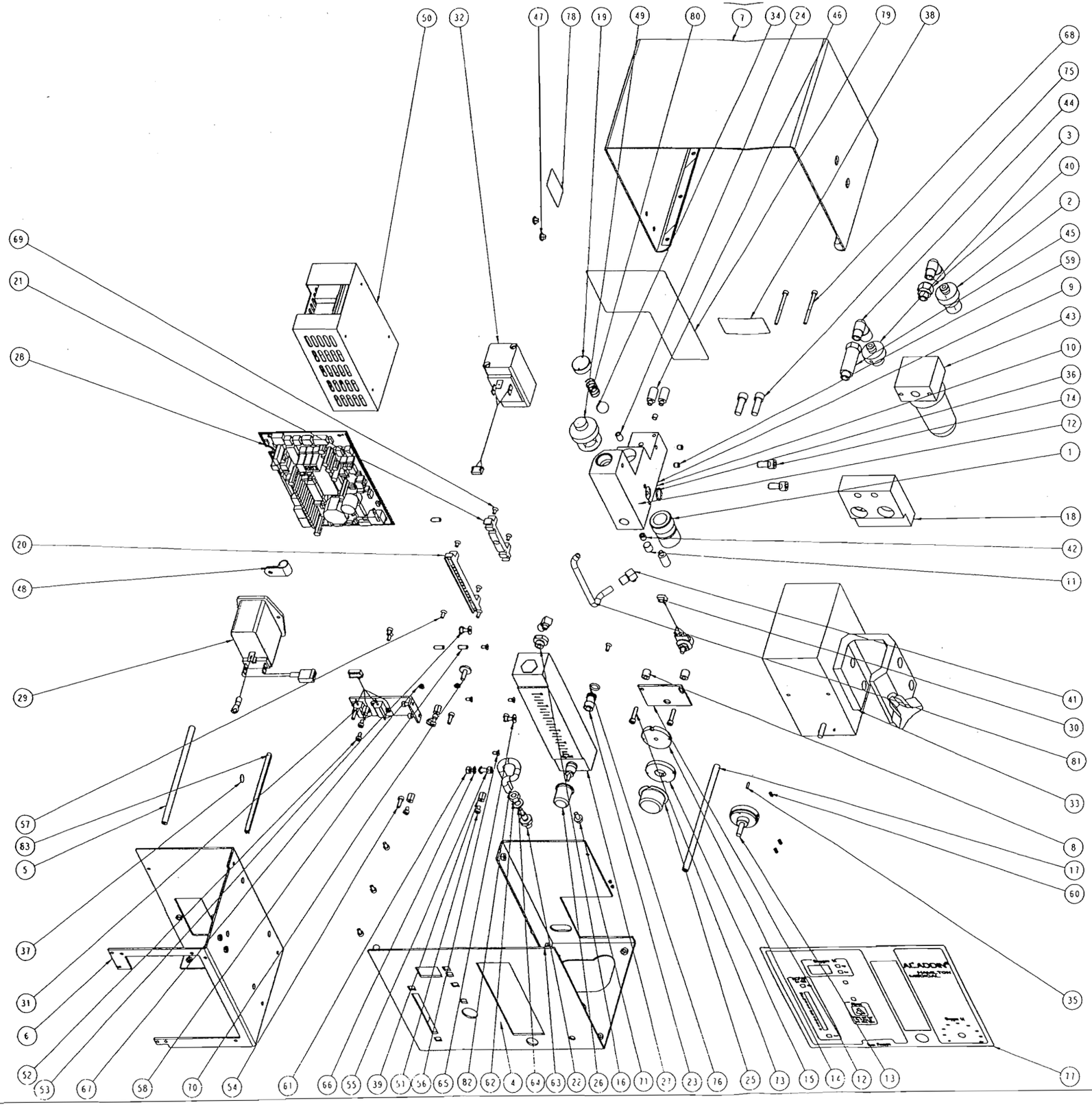
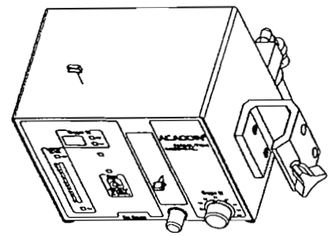
Erstellt: P.Pasquier	Geprüft: N. Bosshard	Freigegeben: A. Hofstetter
Datum: Visum	Datum: Visum	Datum: Visum
25.2.98	26.2.98	19.5.98

\\Geraete\Babyvent\Dokumentation\Detailpflichtenhefte (2003)\	E0252_10.vsd	98.02.24





7/20

83	1249267_ALADDIN	Kunststoffprofil	1	NBR	
82	1249080_ALADDIN	Messschlauch	1	Silikon	
81	1249072_ALADDIN	Schlauch	1		Festo
80	256128_20.0	Druckfeder VD-8980-12	1	1.4301	
79	255761_WARNUNG	Labelsel	1		
78	255761_PARAMETER	Etikette	1		
77	255761_FRONTFOLIE	Labelsel	1		
76	16101_7.5	O-Ring	1	NBR	
75	420557	ZYL.SCHR.M.I-GEI. 1/4-20X3/4"	2	CrNiMo	
74	420556	ZYL.SCHR.M.IGEI.1/4-20X1/2"	2	CrNiMo	
73	420555	ZYL.SCHR.M.IGEI.6-32X5/8"	2	CrNiMo	
72	420554	ZYL.SCHR.M.IGEI.8-32X1/4"	2	CrNiMo	
71	420548	Zyl Schr m. Fle. M4x8	2	1.0037	daccoactivier†
70	420534	FLACHKOPFSCHRAUBE M4X12 DIN921	1	1.0037	
69	420406	SENKSCHRAUBE M3X6 DIN7991	4	1.0037	
68	420062	ZYLINDERSCHRAUBE M3X4G DIN912	2	1.0037	
67	420036	EINPRESSMUTTER M3	2	1.0037	
66	411002	Federscheibe M4 DIN6798	2	Stahl	
65	409200	U-SCHEIBE M3 DIN90218	2	1.0037	
64	409108	U-SCHEIBE M6	1	1.0037	
63	408105	EINPRESSMUTTER M4	1	1.0037	
62	408008	SECHSKANTMUTTER M6	1	1.0037	
61	408006	SECHSKANTMUTTER M4	1	1.0037	
60	405441	GEWINDEST. M3X3 VERZ. DIN916	8	1.0037	
59	405082	GEWINDEST. M5X5 VERZ. DIN913	3	1.0037	
58	405065	GEWINDEST. M4X10 VERZ. DIN913	3	1.0037	
57	403453	SENKSCHRAUBE M3X8 DIN7991	4	1.4305	
56	403452	SENKSCHRAUBE M3X6 DIN7991	4	1.4305	
55	400025	ZYLINDERSCHRAUBE M4X10 DIN912	1	1.0037	
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53	400003	ZYLINDERSCHRAUBE M3X8 DIN912	2	1.0037	
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51	400001	ZYLINDERSCHRAUBE M3X5 DIN912	8	1.0037	
50	396149	Netzteil +5/+15VDC 40W	1	-	
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48	361021	KABELBEFESTIGUNG CX-9	1	PA	
47	281269	Abdeckkappe D:4.35	2	PA	
46	281031	Schalldämpfer	3	Stahl	
45	279707	Distanznippel 1/8"	1	Nippel	
44	279706	Winkelstueck	2	Stahl	
43	279677	Feinfilter 5UM	1	Diverse Mat.	
42	279663	Restrestrer 250	1		
41	279591	Mini-Schnellverschraubung	2	Stahl	
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39	257034	DISTANZHALTER M3X8 1/1-GEWINDE	4	2.0330	
38	255358	SW Etikette MEDICAL	1		
37	255040	Erdungsteher	1		
36	254038	O-Ring	1	NBR	
35	251032	ZYLINDERSTIFT 2X8 DIN6325	1	1.0037	
34	250031	KUGEL D:12	1	1.0037	
33	235788	Air-Oxygen Mixer	1	-	
32	158216	Magnetventil kompl.	1		
31	158215	Leistungseinsatzstecker	1		
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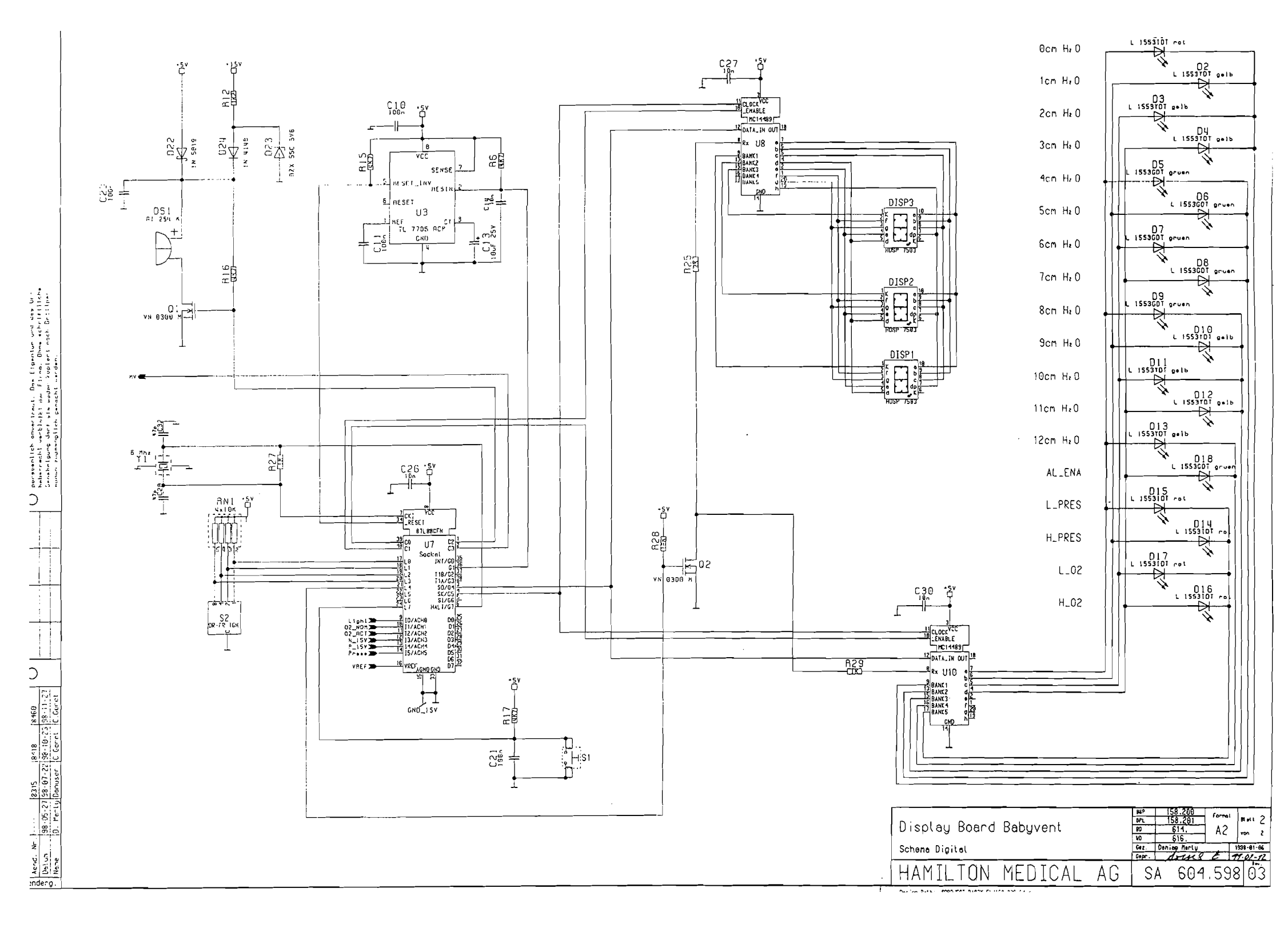
28	158200	Displayboard	1		
27	158141	Rotameter	1	PMMA	
26	158139	Rotameterkopf	1	AA 6012 T6	
25	158138	Mischerkopf	1	AA 6012 T6	
24	158137	Gewindebuechse	1	2.0401	
23	158136	Anschluss	1	2.0401	
22	158135	Messanschluss	1	2.0401	
21	158134	Unterlage 2	1	AA 6060 T6	
20	158133	Unterlage 1	1	AA 6060 T6	
19	158132	Einstellfeder	1	2.0401	
18	158131	Adapter	1	AA 6082 T6	
17	158129	Distanz 2	1	AA 6012 T6	
16	158128	Verbinder	1	2.0401	
15	158127	Zahnrad	1	2.0401	
14	158126	Zahnrad	1	2.0401	
13	158125	Kupplung	1	2.0401	
12	158124	Lagerplatte	1	AA 5005 H24	
11	158123	Stopfen	1	AA 6012 T6	
10	158121	Block	1	AA 5083 H111	
9	158120	Block kpl.	1		
8	158119	Distanzbuechse	2	AA 6012 T6	
7	158114	Verschalung	1	Alu	
6	158113	Einsatz	1	Alu	
5	158112	Distanz	3	AA 6012 T6	
4	158111	Boden	1		
3	155205	O2 - Anschluss DISS	1	AA 6012 T6	
2	155190	Luftanschluss DISS	1	AA 6012 T6	
1	151443	Anschlussstutzen 1	1	2.0401	
Pos.	Artikelnr.	Name/Bezeichnung	Stk.	Material	Bemerkungen

Material	Oberflaeche			
	√(V)			
Driver	Massstab 1/2	Richt fei ± Masse	Blatt 1 von 1	
		Gez. army	1997-11-17	
		Gepr.		
HAMILTON MEDICAL AG	ZCH158100		Rev. 01	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1cm H2O
2cm H2O
3cm H2O
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10cm H2O
11cm H2O
12cm H2O
AL_ENA
L_PRES
H_PRES
L_O2
H_O2
U3
TL 7705 ACP
U7
87L88CFN
U8
U10
MC14489
DISP1
DISP2
DISP3
HDSP 7503
D2
D3
D4
D5
D6
D7
D8
D9
D10
D11
D12
D13
D14
D15
D16
D17
D18
L 1553IDT rot
L 1553IDT gelb
L 1553GDT gruen
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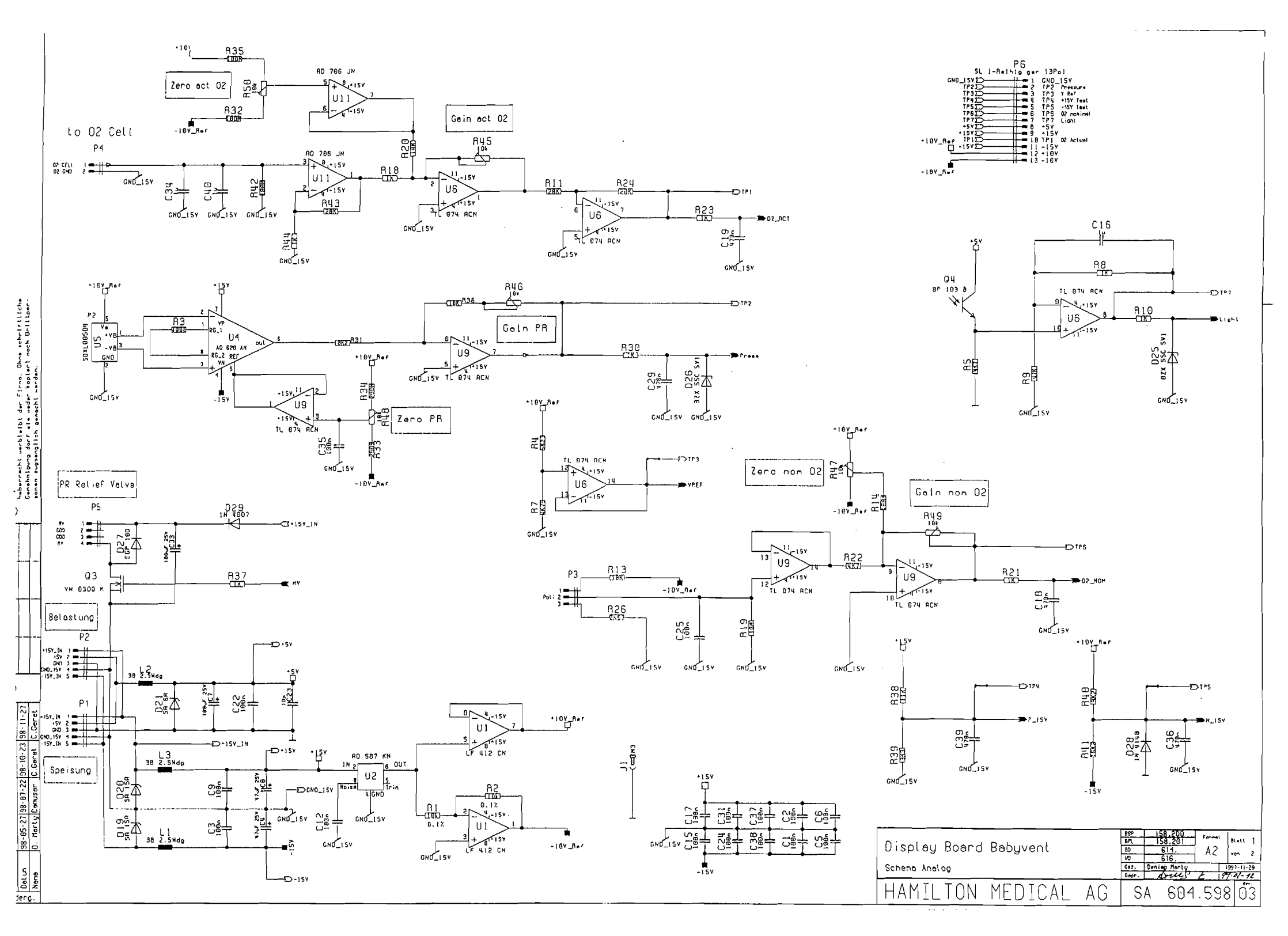
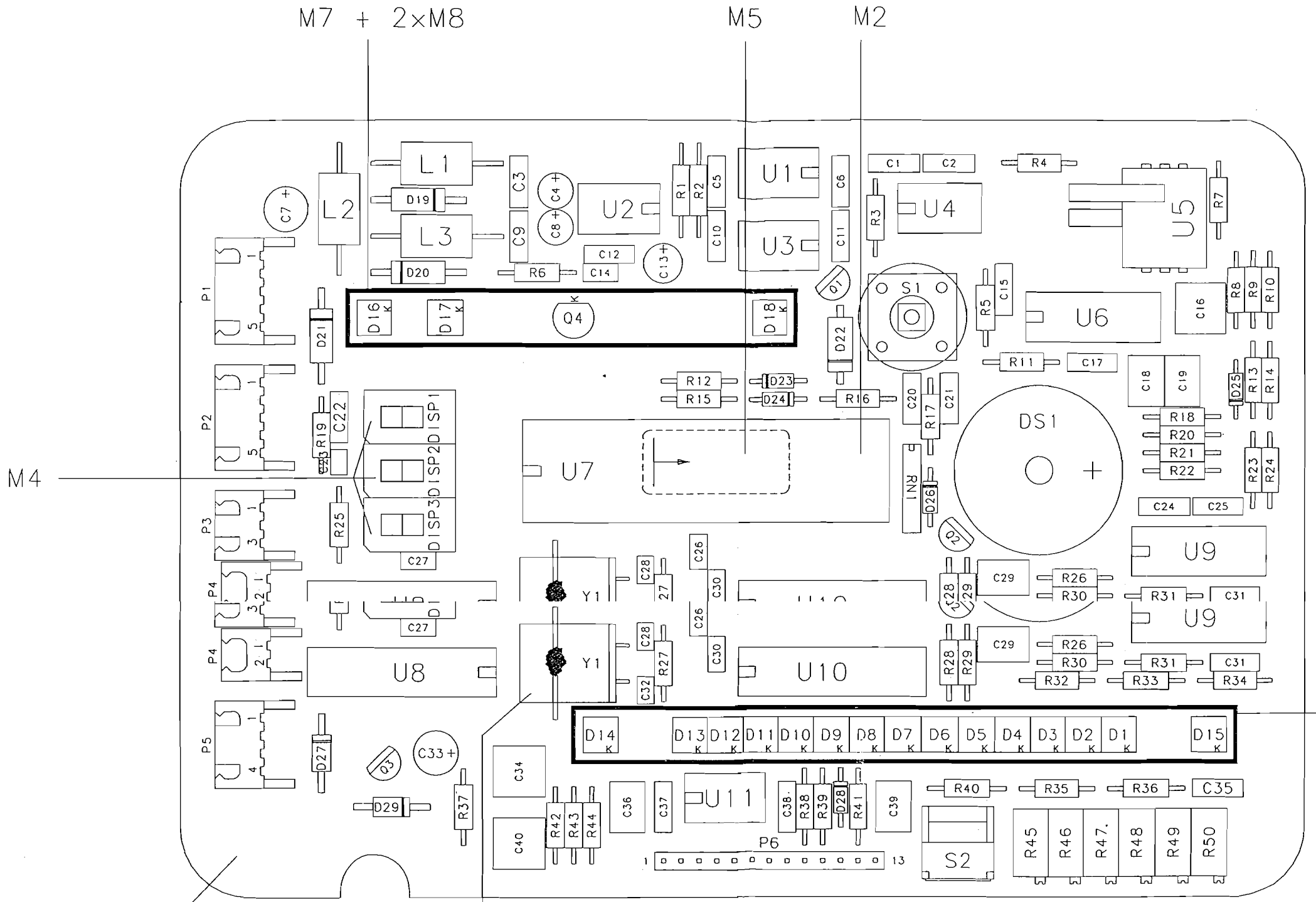
HAMILTON MEDICAL AG
SA 604.598
03


Zero act 02
Gain act 02
to O2 Cell
Gain PR
Zero PR
PR Relief Valve
Zero nom 02
Gain nom 02
Belastung
Speisung
P6
SL 1-Reihig ger 13Pol
Display Board Babyvent
Schema Analog
HAMILTON MEDICAL AG
SA 604.598
03
Format A2
Blatt 1
von 2
Gez. Daniel Marty 1997-11-28
Gepr.
BSP 158.200
BR 158.201
BO 614.
VO 616.

...ies hnl ... t ... j' ...jen ...r 1
lich anvertraut. Das Eigentum und das Urheberrecht ve
bleibt uns. Ohne unsere schriftliche Genehmigung dur
die Zeichnungen weder kopiert noch Drittpersonen zu-
gaenglich gemacht werden.



Aend.Nr.	U1	8418	8446	8460
Datum	98-05-27	98-10-23	98-11-23	98-11-27
Name	D. Marty	C.Geret	C.Geret	C.Geret

Display Board Babyvent Bestueckungsplan	Massstab 1.5 bei A3	BPL	158.201	Blatt 1
		SA	604.598	von 1
		Gez.	Demian Marty	1998-04-22
		Gepr.		99-02-12
HAMILTON MEDICAL AG		BSP 158.200		Rev 23

SECTION 5
ELECTRONIC CALIBRATION

The electronic calibration must be performed by qualified personnel. The calibration procedure must begin with the instrument disconnected from AC power and gas sources. The following procedure will be completed during the annual preventative maintenance and repairs of the ALADDIN II.

Electronic Calibration Set Up

1. Disconnect AC power and Gas Sources.
2. Remove ALADDIN II from the I.V. stand if attached.
3. Remove two screws at pole mount on right side of unit.
4. Remove five screws on bottom enclosure.
5. Resecure pole mount to the right side of the unit.
6. Attach unit to I.V. stand and connect AC power.
7. With the power OFF, set the test switch to position 1 (TS 1). The test switch is located on the left side of the unit, above the calibration potentiometers.
8. Press and hold the Alarm Reset Button on the front Panel and turn on the main power switch ON.
9. After the Software Version has been displayed on the oxygen display release the Alarm Reset Button.
10. The ALADDIN II is now in test mode.

Electronic Calibration ***(Required at Preventative Maintenance and Repairs)***

TS1 Oxygen Cell Calibration

At Position 1, the oxygen display shows the actual oxygen value x2. This Value is from the ADC converter and allows the 2-point calibration of the oxygen cell.

-Connect Air and Oxygen. Display reads 2x oxygen value.
-Set Oxygen knob to 100%, allow 1 minute to stabilize.
-Adjust 100% calibration potentiometer for display of 200.
-Set Oxygen knob to 21%, allow 1 minute to stabilize.
-Adjust 21% calibration potentiometer for display of 42-43.
-Repeat steps until no adjustment is required.

TS2 Oxygen Blender Alarm Position Potentiometer Calibration

The blender alarm potentiometer's function is to allow the microprocessor an electronic method of determining where the gas blender is set to for comparison to the actual oxygen value. A nominal oxygen alarm would result if the values did not coincide.

At position 2, the oxygen display will show the blender alarm potentiometer value x two. This value is from the ADC converter and allows the blender potentiometer to be calibrated to the gas blender.

-Turn test switch to position 2.
-Display reads 2x the effective value.

-Set oxygen concentration to 100 %.
-Adjust Gain O2 Nominal potentiometer for display of 200.
-Set oxygen concentration to 21%.
-Adjust Zero O2 Nominal potentiometer for display of 42-43.
-Repeat steps until no adjustment is needed.

TS3 Pressure Manometer Calibration !! insert set up diagram !!

At position 3, the ADC will convert the analog pressure transducer output to a digital signal for the oxygen display. The display will read x 16 the effective value. The LED display is scaled from 0 – 12 cmH_2O. A 2-point calibration is required.
** The display value cannot be negative and cannot be greater that 255.**
Zero Pressure potentiometer must be calibrated at 1 cmH2o (16 on display).

-Connect test set up in diagram #xx.
-Set pressure to 10 cmH2O.
-Adjust Gain Pressure potentiometer for a value of 160 $\pm$ 1.
-Set pressure to 1 cmH2O.
-Adjust Zero Pressure potentiometer for a value of 16 $\pm$ 1.
-Repeat steps until no adjustment is required.

TS 4 Display Auto-Dimming Check

At position 4, the digital display will show a value from the ADC indicating the brightness level of the LED displays.

-Display value above 50 = Max intensity.
-Display value below 35 = Low intensity.

TS5 + 15 Volt Analog Supply Check

At position 5, the digital display will indicate a value from the ADC. If the value is out of range for longer than 50 ms, a watchdog reset is executed.

-Display value range 189 – 231.

TS6 - 15 Volt Analog Supply Check

At position 6, the digital display will indicate a value from the ADC. If the value is out of range for longer than 50 ms, a watchdog reset is executed.

-Display value range 59 – 113.

Trouble Shooting Tests

TS7 – TSC Oxygen and Pressure Alarm Set Points and Low/High Alarm Points.

The sequence of tests 7 – C will check the alarm set points programmed by holding the ALARM RESET button for 3 seconds. In clinical application this point is set after proper patient setup. In calibration mode it allows the technician to verify the Pressure and Oxygen set point as well as the low and high alarm points.

Oxygen Alarm Test

-Set test switch to position 2.

-Set oxygen to a defined value on the digital display (set point). The set point should not be higher than 200 or lower than 42. The high limit should not be higher than 202. Record value.
-Press alarm reset button for 3 seconds. (Audio alarm and alarm LEDs)
-Return to position 7.
-The displayed value is the set point.
-Position 8 is the High Limit value.
-This value must be 9 higher that the set point.
-Position 9 is the Low Limit value.
-This value must be 9 lower than the set point.

Pressure Alarm Test

-Set test switch to position 3
-Apply 5 cmH_2O to the proximal pressure port. Digital display will indicate 16 x the pressure of 5 cmH_2O (80).
-Press the alarm reset button for 3 seconds, this value is the set point. (Audio alarm and flashing alarm LED's) The set point cannot be >128.

-Return test switch to position "A". This is the set point (80).

-Set test switch to position "B".
-The displayed value is the High alarm limit (128). It should read 48 higher than the set point (80). The high limit cannot be > 176.

-Set the test switch to position "C".
-The displayed value is the Low alarm limit (48). It should read 32 lower than the set point (80). The low limit cannot be < 16.

TS"C" Watch Dog Reset

-Place test switch in position "C".
-Press the alarm reset button. This creates a halt function at the microprocessor causing a watch dog reset. The device will go through it's start up sequence. (lamp test, audio and the software revision display)

TS"D" Circuit Over Pressure Solenoid Test

-Place test switch in position "D".
-The over pressure solenoid will cycle 3 seconds on, 3 seconds off.

TS"E" Display, Buzzer & Photo Cell Tests

-Place test switch in position "E".
-The digital display will count from 0-255. **NOTE**: The display will start the count at some point > 0.

1-Digital Display Test-Press the alarm reset button.
-The digital display will count the 1's digit 0-9 (9 will remain displayed).
-The 10's digit will count from 0-9. (9 will remain displayed)
-The 100's digit will count from 0-9. The test will repeat.

2-Bar Graph Test-Press the alarm reset button.
-0 cmH_2O – 12 cmH_2O will illuminate individually, then all together. Test will repeat.

3-LED test-Press alarm reset button.

-Digital display not illuminated, all individual LED's on.

4-Seven Segment LED Test- Press the alarm reset button.
-Digital display will be illuminated, all individual LED's will be off.

5-Display Test- Press the alarm reset button.
-All seven segment and individual LED's will be on.

6-Display Test- Press the alarm reset button.
-All seven segment and individual LED's will be off.

7-Photo Cell Test-Press the alarm reset button.
-Oxygen display shows the brightness value, all alarm LED's on, bar graph is off.
-Bright light 255 / no light 0.

8- Press the alarm reset button.
-Oxygen display, 8.
-Oxygen High Alarm LED on.

9- Press the alarm reset button.
-Oxygen display, 9.
-Oxygen Low alarm LED on.

10- Press the alarm reset button.
-Oxygen display, 10.
-Alarm Reset LED on.

11- Press the alarm reset button.
-Oxygen display,11.
-High Pressure alarm LED on.

12- Press the alarm reset button.
-Oxygen display, 12.
-Low Pressure alarm LED on.

13- Press the alarm reset button.
-Oxygen display, 13.
-Audio alarm on.

14- Press the alarm reset button.
-Oxygen display, 14.
-Audio alarm off.

15- Press the alarm reset button.
-Oxygen display,15.
-Over pressure valve cycles on / off. (10 second interval)

16- Press the alarm reset button.
-Oxygen display,16.
-Over pressure valve cycling stops.

17- Press the alarm reset button.
-Oxygen display,17.
-The decimal point on the oxygen display is on.

18- Press the alarm reset button.

-Oxygen display,18.
-decimal point is off.
-test pattern 1-18 will repeat.

TS"F" SYSTEM Reset

-Press the alarm reset button.
-Watch dog reset occurs.

POSITION 0

-Perform Functional Test

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